men being transferred, it was impossible to follow the same group of men in all tests. Agglutinations were made with serum diluted from 1:50 to 1:400; but basing our opinion on our comparative experience, we felt that an agglutination in a dilution of 1:100 should be considered positive.

In Groups 3, 4 and 5, agglutination was also attempted in similar dilutions with a local strain of *B. influenzae* obtained from routine throat cultures on the station during the quarantine. The results are shown in Table 5.

TABLE 5.—AGGLUTINATION TESTS

	No. of Men	Days after Inoculation	Agglutinations Positive	Agglutinations Negative
Group 1	16	5	14	2
Group 2	39	30	33	6
Group 3	11	40	1	10
Local strain	11	40	0	11
Group 4	10	50	5	5
Local strain	10	50	0	10
Group 5	6	70	2	4
Local strain	6	70	0	6

CONCLUSIONS

The facts presented undoubtedly indicate that a noteworthy degree of protection against influenza and its complications was obtained by means of a mixed vaccine freshly prepared from predominating etiologic bacteria. These observations should also encourage further work along the line of immunity against pneumonia. To this end an attempt is now being made to regroup the Type IV pneumococcus with the object of adding it to a vaccine when needed.

ABDOMINAL COMPLICATIONS OF THE INFLUENZA EPIDEMIC AT CAMP CUSTER, MICH.

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The abdominal complications of the epidemic of influenza in October, 1918, present problems of interest in diagnosis and treatment. The clinical pictures varied so greatly that a grouping of the cases will be of value.

ABDOMINAL RIGIDITY AND TENDERNESS

The question frequently arose as to whether the boardlike rigidity and tenderness of one or both upper quadrants of the abdomen was due to acute abdominal affection or to muscle spasm from lesions of the chest.

Some of these cases were seen in the first twenty-four hours of the disease, before the physical signs of a pneumonia or of a pleurisy were sufficiently evident to make a positive diagnosis, all available methods, including the roentgen ray, being employed. The upper abdominal pain, with or without accompanying rigidity, which is seen in acute thoracic disease, has always been held to be reflex. Two cases of pneumonia following influenza showed at necropsy localized fibrinous subphrenic peritonitis of limited extent early in the disease, and it seems certain that there is an actual pathologic basis for at least some of these cases of upper abdominal rigidity.

PAIN IN THE RIGHT LOWER QUADRANT

A number of patients were either admitted directly to the surgical wards or seen in consultation in the medical wards for pain in the right lower quadrant. Pain of a dull, aching character referred to the right lower quadrant was the most prominent feature. On examination there was only slight rigidity in a small number, and in the majority there was tenderness over the region of the appendix, but no rigidity. These abdominal signs and symptoms might ordinarily be diagnosed as appendicitis. However, it was repeatedly observed that the local abdominal signs disappeared in a short time; more rarely they persisted and increased in severity so that operation was deemed imperative. This group occurred in influenza patients, nearly all of whom later showed demonstrable signs of bronchopneumonia.

Another group, occurring during the epidemic, neither accompanied nor followed by pneumonia, was made up of a small number of fulminant cases of appendicitis. Operation seemed imperative and was performed under local anesthesia with good results.

PERITONITIS

Of 140 cases of bronchopneumonia following influenza coming to necropsy in all stages of the disease, six (4.2 per cent.) have shown acute peritonitis. Of the six cases, two manifested themselves as local inflammations in the upper left quadrant and were characterized by flakes of fresh fibrin adherent to the spleen and the contiguous surface of the diaphragm. The four remaining cases were generalized. One was extensive, 1,000 c.c. of thick greenish yellow pus being present in the abdomen. Another showed only a few cubic centimeters of pus, and, though generalized, the site of the greatest change was on the adjacent surfaces of the liver and diaphragm. In a third case there was no fluid, but a delicate coat of fibrin formed a layer over the surface of the stomach and the intestinal coils. A fourth case of generalized peritonitis will be referred to under subphrenic abscess. The fact that the process was twice localized to the upper quadrant, and once, while occurring generally distributed throughout the peritoneum, appeared most advanced over the hepatic surface, suggests an origin by direct extension through the diaphragm. In three cases there was a concurrent accumulation of pus on the corresponding pleural side of the diaphragm. On the other hand, a bacteremia was demonstrated in two of the cases during life, and in the heart's blood at necropsy of all except one (this patient had previously been embalmed). In every instance a hemolyzing streptococcus was recovered. In two of these cases pericarditis was an accompanying finding, and in one, jaundice was present. In addition to a bronchopneumonia, which was in most cases resolving, pleurisy was present. It seems certain, therefore, that with hemolytic streptococci in the blood stream and the accompanying involvement of other serous membranes, the peritoneal infection was hematogenous in origin and did not in all cases originate by the more difficult transdiaphragmatic route. In none of these cases was the appendix or gallbladder the site of any change except on the serous coat, as an incident to the general infection of the peritoneum.

After the first inflammatory reaction, a streptococcus infection is prone to proceed even to the point of a large amount of purulent exudate with only a few localizing symptoms or signs. Extensive exudate in the chest cavity is at times found only after the most critical routine examination when there are no signs or symptoms referable to the chest. Similarly a diffuse purulent peritonitis may be present as a part of a generalized infection without attracting especial attention to its presence through the symptoms usually associated with this condition.

In five of the six cases of peritonitis that were found at necropsy, a diagnosis of such a complication was not made during life, although these patients were carefully and repeatedly examined with the possibility of abdominal lesions in mind. The peritonitis was not secondary to any demonstrable abdominal focus, but apparently was merely one manifestation of generalized infection, which frequently was also evident in pleura and pericardium. Suppurative peritonitis was not found in necropsies in the early fulminating cases of the epidemic, but appeared as a part of the late postpneumonic complications, five of the six cases being found in the last thirty necropsies. The early occurrence of deaths did not afford time for the development of this condition. A similar group of cases was noted during the severe infections in the early part of 1918.

SUBPHRENIC ABSCESS

Two cases occurred during the latter portion of the present epidemic which show the necessity of thorough routine examinations:

REPORT OF CASES

CASE 1.—A soldier, admitted, Oct. 8, 1918, with bronchopneumonia involving the right and left lower lobes, complained, November 25, of severe pain in the left upper quadrant of the abdomen. There was slight distention but no rigidity. November 26, 425 c.c. of amber fluid were aspirated from the left pleural cavity, cultures from which showed no growth. November 29, 75 c.c. of pus were aspirated from the same pleural cavity and showed a pure culture of staphylococci. The following day the left chest was again aspirated and a serohemorrhagic fluid obtained through the ninth intercostal space, between the posterior axillary and scapular lines. On pushing the aspirating needle slightly deeper, a thick yellow pus was obtained. Roentgenoscopy had revealed the presence of fluid in the left pleural cavity; hence the outline of the diaphragm on this side could not be seen. A costectomy was performed over the area from which the pus had been aspirated, and 1,500 c.c. of serohemorrhagic fluid were evacuated. The diaphragm was seen to bulge upward and, for this reason, the presence of a subphrenic abscess on this left side was suspected. December 4, the roentgen ray revealed a dense shadow from the sixth rib downward on the left side, and the domes of the diaphragm on the two sides were at about the same level. The normal clear area below the left dome, due to the gas bubble in the stomach, was absent. The tenth rib was resected in the midaxillary line after exploratory puncture had confirmed the diagnosis of a subphrenic abscess. Following the needle, which had been left in situ as a guide, the pleural reflection was pushed upward, an incision made through the muscles of the diaphragm, and 125 c.c. of a dark pus were evacuated. The soldier had no recurrence of elevated temperature and is making an uneventful recovery.

CASE 2.—A soldier, admitted, Oct. 8, 1918, with a diagnosis of bronchopneumonia of all lobes of the right lung, in whose case, October 27, an additional diagnosis was made of acute cholecystitis and cholangeitis, developed a facial erysipelas, the following day, and remained in a very septic condition until November 23, when he was seen by a surgeon in consultation on account of pain in the left upper quadrant. There was dulness over the anterior portion of the left side of the chest in the mammary line just above the costal arch, and an obliteration of Traube's semilunar space. There was also very slight excursion of the left lower lobe into the costophrenic angle. There was also evidence of free fluid in the peritoneal cavity, but no rigidity or tenderness. Roentgenographic examination revealed a shadow in place of the normal gas bubble beneath the left dome of the diaphragm, and displacement of the heart toward the right. The right half of the diaphragm showed such a degree of elevation that a right subphrenic abscess was thought of; but on exploration with a needle, no pus was obtained. Pus, however, was obtained over the left lower chest in the anterior axillary line, and about 90 c.c. of chocolate colored pus were evacuated through an incision in the eighth interspace from the left subphrenic region. The symptoms of a generalized sepsis supervened, and the patient died a few days later. At necropsy the lower lobe of the right lung was found adherent to the diaphragm, and that of the left lung was covered with a thin yellowish exudate. Throughout the liver were scattered many small abscesses. A generalized peritonitis with 1,500 c.c. of free greenish yellow fluid confirmed the clinical diagnosis. The left subphrenic region was walled off, and the origin of the pus obtained at operation was seen to be from an extensive suppurative pylephlebitis. There had evidently been a direct infection of the left subphrenic region from rupture of one of the abscesses in the left lobe of the liver. The gallbladder and the appendix showed at this time no evidence of disease. A number of the mesenteric lymph nodes contained abscesses. A gram-negative bacillus which did not give the typical reaction of the colon group was obtained from the lungs, liver and peritoneum at necropsy.

JAUNDICE

The incidence of jaundice as seen postmortem has been about what one is accustomed to find in fatal cases of lobar pneumonia. Jaundice, in most cases with a marked discoloration of the skin and the mucous and serous membranes, has been present in 7 per cent. of 140 necropsies. In all except one, a bacteremia was demonstrable; *Streptococcus hemolyticus* was present in three, *Streptococcus viridans* in three, and pneumococcus Type IV in two cases. In only one case was there swelling of the ampulla of Vater. In this instance the mucous membrane of the gallbladder and the ducts was slightly swollen and inflamed, being most marked in the cystic duct. The swelling was not sufficient, however, to interfere with the free passage of bile to the duodenum. In all cases, the intestinal contents showed that bile was freely passing into the intestine, and stools examined during life gave no evidence of obstruction to the flow of bile.

SPLEEN

The spleen in the majority of cases was but very little enlarged. It was moderately firm on section and red. Microscopically a rather marked congestion was the predominating feature.

KIDNEY

Cases of true acute nephritis were extremely rare. Acute congestion of the kidneys was frequent. In one case, multiple abscesses of the kidney were a part of a hemolytic streptococcal septicemia, which had also caused a severe infection of one of the toes. Pyelitis demonstrated by ureteral catheterization was occasionally found.

Both renal and perirenal localization may be so severe as to endanger life, either during the stage in which some pulmonary condition is present, or independently of any other demonstrated focus, as is well illustrated in the following case of perirenal infection:

CASE 3.—A soldier, when admitted to the hospital during the influenza epidemic, seven days after sudden onset of headache and fever, complained of a steady aching pain in the right side of the abdomen, extending back to the iliocostal space, unaccompanied by nausea or vomiting. There were no urinary symptoms and no radiation of the pain along the ureter. Boardlike rigidity and marked tenderness were present in the right upper quadrant. The temperature varied from 101 to 104 F., and the white blood count was high (22,000). At times there was also rigidity and tenderness over the right kidney. A roentgenographic examination excluded a condition above the diaphragm, although the latter was 5 cm. higher on the right than on the left side. Ureteral catheterization revealed turbid urine containing staphylococci escaping from the right kidney and clear urine from the left one. During a period of diminished abdominal rigidity, a mass in the region of the kidney was palpated, and at operation a large perinephric abscess was evacuated, followed by an uneventful recovery. The pus from the abscess showed nonhemolytic streptococci and staphylococci.

RUPTURE OF THE RECTUS MUSCLES

Rupture of the rectus muscles occurred with such frequency as to attract special notice. Eight cases showed this condition at necropsy. The rupture occurred regularly midway between the symphysis pubis and the umbilicus. It was never complete, usually involving only a few fibers, and was always bilateral. It was accompanied by hemorrhage under the sheath of the muscles. In one case this hemorrhage was extensive, dissecting its way downward in front of the bladder. In another case a broken down hematoma under the muscle sheath showed hemolytic streptococci. In cases which have been studied microscopically the same condition was demonstrable, namely, polymorphonuclear leukocytes and mononuclear wandering cells accumulated diffusely between the muscle fibers, and here and there localized into definite abscesses. Poorly staining muscle fibers, sometimes broken and contracted with quantities of erythrocytes free in the tissues, completed the picture. The presence of well preserved erythrocytes in the tissues points to the fact that rupture was usually a late occurrence in the disease. The probable explanation of these striking breaks of the rectus abdominis is that a localization of the infection in these muscles with abscess formation so weakens the muscle that rupture occurs with violent coughing or terminal muscle spasms. In three of the cases the cough had been so severe that a special notation of the fact was made on the daily record.

THROMBOPHLEBITIS

Thrombophlebitis occurred four times (2.7 per cent.). In three cases it led to pulmonary embolism. In one case the thrombus had its origin at the bifurcation of the inferior vena cava, extended into the iliacs of both sides, and could be traced in the femorals to the middle of both thighs. This patient had marked swelling of both legs to the iliac crests. In another instance the right internal iliac vein was the seat of the thrombus, and in a third, old infarcts and plugged pulmonary vessels had their origin in a similar phlebitis which had had time to heal in part before the death of the patient from his pulmonary infection occurred. Blood cultures were negative in all cases during life and at necropsy. This affection is also one of the late manifestations of the epidemic and occurred in those patients who had been sick a month or more.

A YEAST MEDIUM FOR PROLONGING THE VIABILITY OF THE MENINGOCOCCUS *

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At present the need is felt for a simple medium for prolonging the viability of the meningococcus. A variety of mediums have been devised with this object in view, but generally they are prepared with difficulty, as in the cases in which animal blood is used, or they do not sustain the organism a sufficient time. In this communication a medium is presented which is simple to prepare and prolongs the viability of the meningococcus for at least a month.

Yeast contains elements necessary for bacterial growth and maintenance. Ickert[1] found that certain organisms thrive on yeast peptone agar although free from meat infusion or meat extract. The following is an adaptation to the meningococcus of Ickert's findings, using a modified medium:

PREPARATION OF THE MEDIUM

Ten gm. of bakers' or brewers' yeast are macerated in 100 c.c. of water for twenty minutes, and the suspension is steamed for two hours, the temperature not exceeding 100 C. It is then clarified by adding Merck's dialyzed iron (5 per cent. ferric oxid) and filtering through glass wool. The first step in this clarification is not necessary unless a specially transparent medium is desired. To 1 per cent. agar containing 2 per cent. peptone and 0.4 per cent. potassium phosphate is added an equal amount of the prepared yeast. The reaction is adjusted to $p_H = 7.6$, which, after heating, is reduced to 7.4. The medium is distributed, 10 c.c. in each tube, and is autoclaved for one-half hour at 15 pounds.

The result is a semisolid medium which is seeded by making stabs into it with a considerable amount of the inoculum. The tubes are sealed with paraffin or sealing wax and are kept at 37 C. until required.

REPORT OF EXPERIMENTS

Several strains of meningococci, normal, irregular, and para, spinal and nasal, recent and old, were seeded in this medium, and at the end of one month were still viable. In one instance the organism was recovered after seven, and in another after eleven weeks. If, after initial incubation, the cultures are kept at room temperature (from 23 to 26 C.), the period of viability is three weeks.

To test for viability, a small amount of the medium is transferred to sheep serum agar slants. It is important to note that the meningococcus produces no visible change in the medium. Indeed, a dried substrate may yield actively growing organisms. Hence a test is a necessary procedure. At times the mere transplanting to sheep serum agar slants fails to yield a growth. In such cases a small amount (from 0.5 to 1 c.c.) of 1 per cent. glucose broth is added to the yeast medium, and after from twenty-four to forty-eight hours' incubation a transplant is made to the sheep serum agar slants.

Further work is necessary to determine whether this medium is suitable for repeated transfers. However, its advantage in keeping the meningococcus alive

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1. Ickert, F.: Presshefe und Hefeextrakt zur Nährbodenbereitung, Deutsch. med. Wchnschr. **44**: 186, 1918; abstr. Daily Review of the Foreign Press, May 1, 1918, p. 147.